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THE TOPOGRAPHICAL WORK OF THE GEOLOGICAL SURVEY OF CANADA.

By **James White,** Chief Draughtsman of the Survey.

From 'The Geographical Journal' for December, 1897.

THE TOPOGRAPHICAL WORK OF THE GEOLOGICAL SURVEY OF CANADA.*

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Most of the difficulties encountered in making a geological survey of Canada have arisen from the want of good topographical maps. In the absence of an ordnance or similar survey, the Geological Survey, as the only organization charged with the mapping of the Dominion as a whole, has had to undertake, concurrently with the geological work, extensive topographical surveys from its very inception to the present time. The surveys in Canada that are available for topographical maps are, in general, Dominion Lands and Crown Lands surveys. The former is based on an accurate system, but applies only to Manitoba, the North-West Territories, and a narrow belt along the Canadian Pacific railway in British Columbia; and its operations have, thus far, been confined to a portion of the railway belt, and to the country south of the North Saskachewan and lying between the Rocky mountains on the west and the boundary between Ontario and Manitoba on the east.

The Crown Lands Departments of Ontario and Quebec have made cadastral surveys in the southern portions of their respective provinces from time to time, to meet the requirements of advancing settlements. As these townships are surveyed independently, and sometimes not very correctly, extensive surveys have to be made to check and correct them, and to add roads, railways, etc., that have been constructed since they were surveyed. The other provinces have made no surveys available for mapping purposes except in isolated areas.

Again, the Geological Survey, as the pioneer preceding the lumberman, the miner, and the settler, has frequently to make explorations and surveys in districts that are subsequently cadastrally surveyed by the Dominion Lands or Crown Lands. The maps issued by the survey may conveniently be divided into—

(1) Preliminary maps on scales varying from 8 to 25 miles to 1 inch. These are usually the results of reconnaissance and exploratory surveys in the great areas of Northern Canada.

(2) Detailed maps on scales of 1, 4, and 8 miles to 1 inch. These maps are published in sheets of standard size and on standard scales, and their publication must obviously proceed more slowly than those of the first class.

As the topographical work of the survey is for mapping purposes only, it is necessary to strive after no greater accuracy and no greater detail than is required for the scale of the map in view. The methods of survey used are therefore of an elastic nature, varying with varying circumstances, and are usually a combination of two or more of the following:—

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(1) Transit or compass and chain surveys or triangulation.

(2) Micrometer or, if on roads, odometer surveys.

(3) Paced surveys.

(4) Track or time surveys checked by sextant latitudes, and sometimes by longitude observations.

The order of description is by provinces, commencing with Quebec and Ontario, the two provinces of Canada till confederation in 1867, and then the others in succession from east to west. While the work on the standard sheets is not less important, and does not require less ability or diligence on the part of those engaged in it than the exploratory surveys of the north and west, yet, as a description would be largely a recital of the number of miles of roads, lakes, and streams surveyed in each year, it has been abbreviated, and the sheets in each province dealt with *en bloc.*

QUEBEC.—In 1844 and 1845 Messrs. Logan and Murray made a triangulation of the peaks in the hills that form the watershed of Gaspé peninsula. They also made micrometer surveys of portions of the Chatte, Great Cascapedia, Bonaventure, Matane, St. Anne, and St. John's rivers, in all 299 miles. In 1857 and 1858 the work in this district was continued by Mr. Richardson, who surveyed the Magdalen, Restigouche, Patapedia, and Great Metis rivers, and several tributary streams and lakes, in all about 200 miles. In 1862 Mr. Bell surveyed portions of the Dartmouth, York, Malbaie, and Grand rivers, for an aggregate distance of 106 miles. In addition, about 100 miles of traverse-lines were measured with the micrometer. In 1858 Sir W. E. Logan surveyed the upper part of the River Rouge and thirty-two tributary lakes. Dr. Ells in 1881 to 1883, and Mr. Low in 1882 and 1883, completed the information required for the mapping of Gaspé peninsula, 15,100 square miles, on the 4-mile scale. Dr. Ells made a chained survey of the shore-line road from Little Pabos, on the bay of Chaleurs, to Grand Metis, on the St. Lawrence, and micrometer surveys of the Salmon branch of the Cascapedia, Grand Pabos, and upper portion of the Bonaventure. Other roads and the coast-line were measured by pacing; Mr. Low triangulated the peaks in the Shickshock mountains, and made micrometed traverses of the south branch of the Ste Anne, Little Cascapedia, and west branch of the Magdalen rivers.

In 1858 Sir W. E. Logan surveyed the upper portion of the river Rouge and thirty-two tributary lakes in the Grenville district. These surveys, with the subsequent measurements, in the same district, by himself and Mr. J. Lowe, amount to about 2600 miles, and form the basis of the so-called Grenville map, covering an area of 1200 square miles.

The work on what is known as the "Eastern Townships" map-area was commenced by Sir W. E. Logan in 1848, and continued by himself, at varying intervals, up to 1871; by Mr. Richardson in 1850 to 1852, 1854, 1855, and 1863 to 1868; and by Mr. Webster from 1870 to 1876. The paced measurements of roads and exploration lines by Messrs. Logan, Richardson, and Webster amount to about 17,000 miles, and cover an area of 26,380 square miles. The publication of the three sheets thus far issued was delayed by the uncertainty as to the exact horizon of some of the members of the Quebec group, so called. The additional surveys, to bring them up to date, necessitated by this delay, were made by Messrs. Ells in 1886 to 1890; Garoux in 1886 to 1894; Adams, 1886 and 1887; A. R. Low in 1889 and 1891; and McConnell and Ord in 1880; in all about 8600 miles.

In 1857 Lieut. Ashe determined, telegraphically, the longitude, as compared with Cambridge, of Quebec, Three Rivers, Montreal, Ottawa, Kingston, Toronto, Collingwood, Windsor, and Chicago. So uncertain were the longitudes at that time, that an important place like Chicago was placed by the two best authorities as in longitude 88° 23′ and 87° 28′ W. respectively, whereas Ashe's observations gave 87° 37′ 44″, a difference of 9′ 44″ in one case, and of 45′ 16″ in the other. Signals were interchanged with Cambridge which had been determined by the interchange of several hundred chronometers with Greenwich.

In 1870 Mr. Richardson made a micrometer survey of the canoe-route from the upper portion of the Ashuapmouchouan river, by Nikobau River Lake, Abatagamaw and Chibougamoo lakes, to Lake Mistassini, and of the shore-line of the latter for 30 miles. His provisions failing to reach him, he was forced to abandon the survey of Mistassini and return to Lake Nikobau, where they were stored. From Nikobau he carried his traverse by the Foam-fall and Clearwater rivers to the St. Maurice, which had been surveyed previously by the Crown Lands Department. From Kirkendach, on the St. Maurice, a survey was made of the route by the Hair-cutting river and south-east branch of the Gatineau, and the Gatineau to the Desert. Of the surveys thus made, 274 miles were measured with the micrometer, and 300 miles were track survey.

In 1871 Mr. McOuat carried a micrometer-traverse in a north-westerly direction for 90 miles from the Mistassini river to the lake of the same name, and thence along the lake-shore to the end of Mr. Richardson's survey of the previous year. He also surveyed 150 miles of the coast-line of the lake to a point on the main north-west shore, about 70 miles from the extreme south-west point.

In 1885 Mr. A. P. Low commenced at the terminal point of Mr. McOuat's survey, carried his traverse up the west side to the north end, and down the east side to Big Narrows, where he connected with McOuat's survey 139 miles. He found the average length of the lake to be about 100 miles, and average width 12 miles. From the outlet of the lake he made a track survey of the Rupert river to Hudson bay, 300 miles.

In 1891 to 1894 Dr. Ells made about 3200 miles of odometer and 400 miles of paced surveys in the Grenville and Pembroke map-areas, 6900 square miles.

Labrador Peninsula.—In 1887 Mr. A. P. Low surveyed Agumska, Weston, and other islands in James bay. In the following year he made a track-survey of Big river from its mouth upwards for 160 miles, of the canoe-route by the headwaters of Bishop Roggan river to the south branch of Great Whale river, and of the latter to the main stream, and thence to Hudson bay, 350 miles. He also made a micrometer survey of the route from Richmond gulf to Clearwater lake, 63 miles. In 1892 Mr. Low made a micrometer traverse from Lake Mistassini by the Rupert, Kawashagami, and East Main rivers to Hudson bay, 326 miles, and of the East Main between the Kawashagami and Chegami branches. In 1893 and 1894 Mr. Low, with Mr. Eaton as topographical assistant, continued his explorations in the Labrador peninsula. The micrometer traverse was continued from the mouth of the Tshegami branch, where it connected with the surveys of the previous year, up the East Main river, 104 miles, to where the route to Nichieun leaves the main stream. From this point a track survey, checked by sextant latitudes, was made of the route by way of the headwaters of Big river, Nichieun, and Kaniapeskau lakes, and the Koksoak river to Fort Chimo, upwards of 600 miles. In February, 1894, having wintered at North-west River Post, a micrometer survey was carried from the post up the Hamilton river to Sand-girt lake, thence up the Attikonak branch to the Height of Land, down the Romaine river for 115 miles, thence by portage-route to the St. John river, 702 miles. From this point a track survey was made to the mouth, 73 miles. From Sand-girt lake micrometer surveys were made of the Ashuanipi river, Petitsikapow, and other lakes, 293 miles, and track surveys of the canoe-route to Lake Michikamau, and of the lake itself, 269 miles. Total in the two years, 1100 miles of micrometer, and 940 miles track surveys. In 1895 Messrs. Low and Eaton made a micrometer traverse from the head of Lake Mouchalagan by way of the headwaters of the Manicugan and Outardes rivers to the Height of Land, and thence by a chain of lakes to Naokokan lake, on Big river. In 1896 Mr. Low continued his micrometer survey of 1888 from the outlet of Clearwater lake, surveying Clearwater and Lower Seal lakes, and Larch and Koksoak rivers, to Mugava bay.

In 1887 Mr. Cochrane made a track survey of Twenty-mile bay of Grand lake, of a chain of lakes and streams to Shabogama lake, and of the Mekiskan river to Red Flower-hill portage.

In 1895 Dr. Bell made a micrometer survey of the Mekiskan from the end of Mr. Cochrane's survey to Mattagami lake, of Mattagami lake and Nottaway river, and of the shore-line of Rupert bay to Rupert House. A track-survey was made of Waswanipi lake and river between the Hudson's bay post and Lake Mattagami. In 1896 Dr. Bell, with Mr. Brock as assistant, made track surveys of the Mekiskan river between Shabogama lake and where the route to Waswanipi leaves it, and of the lower portions of its principal branches; of the route from Waswanipi post to Lake Nemiskan on the Rupert river, and of the route by way of Waswanipi river from the post of the same name to Wakanichi lake, where it connected with Mr. Richardson's traverse of 1870.

New Brunswick.—The topographical work in New Brunswick, commenced by Mr. Robb in 1868 and 1869, was continued by Dr. Ells in 1873–78, and by Mr. Broad in 1878–82 in the southern portion of the province. The north-eastern portion was surveyed by Dr. Ells and his assistants in 1879, 1880, and 1881, and the north-western and adjoining portions of Quebec by Mr. McInnes in 1884–89. It is difficult to give an estimate of the distances measured, but Dr. Ells in 1877 to 1880 surveyed 2950 miles with chain odometer and pacing, an average of nearly 750 miles a year. These surveys, with the topographical information available from other sources, furnished the material for mapping the province—27,200 square miles on a scale of 4 miles to 1 inch.

Nova Scotia.—Sir W. E. Logan in 1868, and Mr. Hartley in 1868 and 1869, made a survey of the Picton coalfield; in the Springhill coalfield, Mr. S. Barlow in 1871 to 1877, and Mr. McOuat in 1873 and 1874, made chained surveys aggregating over 1300 miles. The survey of the island of Cape Breton, commenced in 1872 by Mr. Robb, and continued by Mr. Fletcher after the death of the former in 1874, was completed in 1882. Since 1882 Messrs. Fletcher and Fairbault have extended these surveys westward on the mainland to Windsor on the Bay of Fundy and Halifax on the Atlantic coast. Thus, with the island of Cape Breton, 13,180 square miles have been surveyed in detail for mapping on a scale of 1 mile to 1 inch. Messrs. Fletcher and Fairbault estimate the measurements made by themselves and their assistants at 34,600 miles. In 1881 Mr. W. B. Dawson made a topographical survey of the Laurencetown, Montagu and Waverly goldfields, the cost being borne in equal proportions by the Survey and Provincial Government. In 1884 Messrs. Ells, A. E. Barlow, and Giroux made chain, micrometer, and paced surveys aggregating 1003 miles, to complete for publication the Cumberland coalfield map, begun by Mr. S. Barlow some years previous.

Ontario.—In 1845 Sir W. E. Logan made a micrometer survey of the Ottawa river from the Joachim rapids to the head of Lake Temiscaming, and of the Mattawa river from its mouth to the Lake Nipissing portage, in all 280 miles. The work in this district was continued in 1847 and 1853–56 by Mr. Murray. During these years he surveyed Lake Nipissing, the French, Sturgeon, Wahnapitai, Spanish, Maganetawan, Muskoka, Petawawa, Bonnechere, and York rivers and numerous tributary streams and lakes. In 1857 and 1858 he surveyed the Thessalon, Missisanga, Goulais and numerous other streams and lakes between Blind river and Lake Superior. Mr. Murray's surveys in 1847 and 1853-58 amount in the aggregate to 2780 miles measured with the micrometer, besides between 300 and 400 miles by pacing. In 1846 Mr. Murray surveyed the Koministiguia for 40 miles; and in 1852 a number of lakes and streams between Kingston and Balsam lake, 400 miles. In 1869, 1870, and 1871 Dr. Bell surveyed Nipigon and Long lakes, White, Black, Nie, English (East) and Kenogami rivers, the canoe-route from Lake Nipigon by way of Ombabika and Albany rivers to the confluence of the latter with the Kenogami, and numerous lakes and streams between the Nipigon and the Pie—total, 1865 miles of micrometer, 181 miles of paced, and 367 miles of track surveys.

In 1872 Messrs. Selwyn and Bell made a joint track survey of the canoe-route from Hawk lake by the English river (west) to Separation lake, where they separated, Dr. Selwyn continuing the survey down the English and Winnipeg rivers to Lake Winnipeg, 461 miles from Hawk lake; and Dr. Bell by Sandy portage and the Winnipeg river to Rat portage, 29 miles from Separation lake. In 1872 Mr. McOuat made a micrometer survey of Lake Abitibbi and of the river of the same name to the first fall. In 1877 Mr. Cochrane surveyed the river from the end of Mr. McOuat's survey to its confluence with Morse river.

Dr. Bell, in 1875, surveyed the upper portion of the Montreal (west), the Mattagami, Missinaibi, Michipreston, and lower portion of the Moose rivers; in 1885, Lakes Wabatongwashene, Oba, Esnagami, and other lakes and streams in the vicinity; and in 1885 Lake Seul, Lake Joseph, the Attawapishkat river from Lake Lansdowne to Hudson bay, the shore of Hudson bay between the mouths of the Attawapishkat and Albany, and the Albany, except the portion surveyed by himself in 1870. In 1887 Dr. Bell made a track survey of the canoe-route from the great bend of the Montreal (east) river to Raish-ko-chagami lake on the Frederick House river.

Messrs. Lawson and J. W. Tyrrell in 1883 and 1884, and Messrs. Lawson, A. E. Barlow, and Smith in 1885, made a detailed survey of the Lake of the Woods, Rainy lake, the Winnipeg river from Rat portage to the Dalles, and other lakes and streams in the vicinity, for publication on a scale of 2 miles to 1 inch. This work has been extended to the north and east over the Rainy lake, Hunter's island, Seine river, Shebandowan and Manitou sheets, by Dr. Dawson in 1886 and 1887, Mr. Smith 1888 to 1891, and Mr. McInnes 1890 to the present time. These sheets are published on the 4-mile scale, and cover an area of 19,230 square miles. They are full of lakes and connecting streams, the water-routes thus formed being the only means of communication through the greater part of the district. Of the larger lakes, the Lake of the Woods has an area of 1770 square miles, Rainy lake 345 square miles, Lac des Mille Lacs 105 square miles.

Messrs. Bell and A. E. Barlow in 1888 to 1891, to complete the information for the Sudbury and French river sheets, made micrometer surveys of the upper portion of Spanish river, Panach and Rogomasing lakes, and Veuve and Vermilion rivers, the shores and islands of Bay of Islands, and McGregor bay and peninsula. In 1892 Dr. Bell surveyed Key, Henvey, and Byng inlets. Mr. Barlow in 1887 made a micrometer survey of Lake Temagami, and in 1892 and 1893, with Mr. Johnston as assistant, surveyed the western portion of Lake Nipissing, Abashing and Keepawa lakes, canoe-route from Temagami to the mouth of Temagami river, and made paced surveys of the roads in the Nipissing and Temiscaming sheets—in all 1080 miles of micrometer, 170 miles of paced, and 45 miles of boat-log surveys.

In 1895 and 1896 surveys of roads, amounting in the aggregate to about 5100 miles, were made by Dr. Ells, Mr. Grioux, and Messrs. Adams and Barlow in the Pembroke, Cornwall, and Haliburton map-areas respectively. In the same years the writer made a traverse with transit and chain across the province from Georgian bay to Kingstown. In 1893 Mr. Dowling made log surveys of Red Trout and Gull-rock lakes, and track surveys of the connecting streams, of the Mattawa, and upper portion of Berens river.

MANITOBA AND NORTH-WEST TERRITORIES.—In 1873 Dr. Selwyn made a track survey of the Saskachewan river from Rocky Mountain House on the North Branch to Cumberland House, 798 miles. In 1878 and 1879 Dr. Bell made track surveys of the shore of Lake Winnipeg between Dog Head and Drunken river; of the Nelson, Hayes, and Grass rivers; of the canoe-route from Split lake on the Nelson to the Churchill and lower portion of the Churchill, in all 1710 miles. In 1879 Mr. Cochrane, Dr. Bell's assistant, surveyed Gode and Inland lakes, the eastern portion of Oxford lake, and the connecting streams, 585 miles. In 1880 and 1881 Mr. Cochrane made track surveys of—

(1) Canoe-route from Cross lake by Pine, Moose, and Saskachewan rivers to Cumberland House, 242 miles.

(2) Canoe-route by Grassberry river to Thog portage, thence by Churchill and Deer rivers to Reindeer lake, and Reindeer lake, 763 miles.

(3) Route by Cochrane river, Hatchet lake, and Black river to Lake Athabasca, and north shore of the lake, 625 miles.

(4) Athabasca river from the mouth to its confluence with the Clearwater, thence by the Clearwater and Churchill rivers to Thog portage, 760 miles.

(5) Route from Pelican lake to Cumberland House.

Total measurements, 2390 miles.

In 1881 and 1882 Dr. Dawson, with Mr. McConnell as assistant, made 2315 miles of odometer, and 110 miles of paced and track surveys in the country between Medicine Hat and the Rocky mountains on the east and west, and the 49th parallel and the Red Deer river on the north and south respectively. Dr. Dawson, with Mr. Tyrrell as assistant in 1883, and with the writer as assistant in 1884, made a reconnaissance survey of that portion of the Rocky mountains lying between the parallel of 49° and 51° 30′. These surveys were continued northward to the North Saskatchewan by Messrs. McConnell and the writer in 1885, and by Messrs. McConnell and Russell in 1892.

In 1883 and 1884 Mr. McConnell, with Mr. Dowling as assistant in the latter year, made 1800 miles of odometer surveys of trails and exploration lines, and 250 miles of river traverse in the country between Medicine Hat and the eastern end of the Cypress hills on west and east and the 49th and 51st parallels. Mr. Tyrrell in 1885, and Messrs. Tyrrell and Dowling in 1886, made similar surveys and explorations in that portion of Alberta and the adjoining districts, lying between 110° W. and 115° W. and 51° 30′ N. and 54° N.

The above-mentioned surveys of Messrs. Dawson, McConnell, and Tyrrell have been published, on the scale of 8 miles to 1 inch, in the Bow and Belby, Cypress hills, and Northern Alberta maps, and cover an area of 100,000 square miles.

In 1882 Mr. Cochrane made track surveys of Berene, Big Black, and Poplar rivers, and of the headwaters of Severn and Pigeon rivers, 287 miles. In 1886 Mr. A. P. Low made a micrometer traverse from Lake Winnipeg to Hudson bay by way of the Buens river to Family lake, thence by the headwaters of Poplar river and the middle branch of the Severn to Severn lake, thence by the Fawn and Severn rivers to Fort Severn, 882 miles.

In 1887 to 1891 Messrs. Tyrrell and Dowling surveyed, with micrometer or boat-log, Winnipegosis, Dauphin, Red Deer, Waterhen, and other lakes and portions of Lake Winnipeg; also made track surveys of the Bad-throat and other rivers to the east of Lake Winnipeg, and odometer surveys of trails and exploration lines in North-Western Manitoba. In 1895 and 1896 Mr. Tyrrell continued the work in this district, and surveyed the Gunisao, Black, Pigeon, Blood, Pine, and Wolf rivers, the Playgreen lakes, the canoe-routes from Sipi-wesk lake to Nelson House, and from Paint lake to Sturgeon river.

In 1887 Mr. McConnell surveyed the Liard river, from the mouth of the Dease to the Mackenzie, and the lower portion of Hay river. In the winter of 1887-88 track surveys were made from Fort Providence northward to Fort Rae, and southward to Lake Bischo. In 1888, as Mr. Ogilvie had been instructed to make a micrometer survey of the Mackenzie river and Peel river portage, a sketch traverse of the river and mountain features only was made of this portion of the route. A detailed running survey was made of the Porcupine river from the mouth of Bell's river to the Yukon. In 1889 and 1890 Mr. McConnell made track surveys of the route between the Peace and Athabasca rivers by the Pelican, Loon, and Wabiskaw rivers, 400 miles; of the Red river from its mouth upward for 200 miles; of the trials to the Buffalo-head hills and Trout lakes, and of the tributaries of the Athabasca below Fort McMurray. In 1892 Messrs. Tyrrell and Dowling made traverses of the Beaver, Mudjatick, Cree, Black, Geikie, and Whitefish rivers, of Black and Reindeer lakes, and of the south shores of Athabasca and Wollaston lakes. Distances were estimated, except on lakes and quiet reaches, which were surveyed with boat-log. They also made micrometer surveys of Black and Deer rivers, and of the Churchill between the mouth of Deer river and Frog portage.

In 1893 and 1894 Mr. J. B. Tyrrell made exploratory surveys in the "Barren Lands." In 1893, with Mr. J. W. Tyrrell as topographer, he made a traverse from Lake Athabasca to Hudson Bay. A survey of the north shore of Lake Athabasca from Chipewyan to Fond du Lac was made with boat-log and solar compass. From Black lake the survey was carried by the Cnipman and Dubaunt rivers to the head of Chesterfield inlet, 905 miles. Of this distance 290 miles were on rivers, where the distances were estimated, and 615 miles were through lakes, where the distances were measured with a boat-log, and bearings taken with solar or prismatic compass. As the tides prevented the use of the log with any degree of accuracy, the traverse of Chesterfield inlet and west coast of Hudson bay to lat. 61° 32′, where the severity of the weather compelled the abandonment of the survey, was a time survey. A similar survey was made of the 200 miles between Fort Churchill and York.

In 1894 Mr. J. B. Tyrrell carried another traverse from Du Brochet post on Reindeer lake by the Cochrane, Thlewiaza, and Kagan rivers to lat. 63° 7′, thence eastward by chain of lakes and the Ferguson river to Hudson bay, 815 miles. From the point at which he abandoned his survey the previous year, he continued it southward to Churchill. A time survey was made of the route between Churchill and Gull lake. Total distance surveyed in 1893 and 1894, 2900 miles, of which 1073 miles were log, 1312 track in canoes, and 515 part track survey on foot and part pacing. The distances thus obtained were checked by numerous observations for latitude.

British Columbia.—In 1871 Mr. Richardson made paced surveys of roads in the country between Yale and Quesnel, aggregating 428 miles. From 1872 to 1874 he was surveying stream trails and exploration lines in the Comox and Nanaimo coalfield. In 1875 Dr. Selwyn made a time survey of the trail from Quesnel to McLeod's lake, of the canoe-route from McLeod's lake by the Pack, Parsnip, and Peace rivers to Smoky river forks, and of Pine river from the "forks" to its mouth. During 1875 and 1876 Dr. Dawson surveyed trails, lakes, and streams in the country between the Fraser river and the coast range on the east and west, and Bella Coola valley and Francois lake on the south and north respectively. In 1878 Dr. Dawson surveyed the islands, channels, and inlets of the north and east coasts of the Queen Charlotte islands. In 1879 Dr. Dawson made a traverse from the Skeena river to Edmonton. From Hazelton the survey was carried by the trail from Hazelton to McLeod's lake, thence by the valley of the Parsnip and the Pine river pass to the "lower forks" of Pine river, thence across country to Dunvegan. From this point side traverses were made through Grande Prairie and southward to Smoky river, and of the lower portions of the Wapiti and Smoky rivers. From Dunvegan an exploratory traverse was made to the Athabasca river, near the mouth of Marshhead creek; from this point the survey was carried down the Athabasca, with a side traverse of Lesser Slave lake and river, to Athabasca landing, and thence by trail to Edmonton. The trail from Smoky river "forks" to old Fort Assineboine was surveyed by Dr. Dawson's assistant, Mr. McConnell. In 1885 and 1886 Mr. Bowman triangulated the peaks in the Cariboo district, and measured 255 miles of roads and trails.

In 1887 Dr. Dawson, with Messrs. McConnell and McEvoy as assistants, made an exploratory survey of the region of the headwaters of the Yukon, Liard, and Stikine rivers. Mr. McConnell made a micrometer survey of the Stikine from the end of Hunter's survey to Telegraph creek. A carefully paced traverse was made from Telegraph creek to Dease lake by Mr. McEvoy. From Dease lake Dr. Dawson made a detailed track survey, following the lines of the Dease, Upper Liard, and Pilby rivers to the confluence of the latter with the Lewes, about 900 miles. He also carried it up the Lewes to enable him to add the mountain features and make some additions to the lakes as surveyed by Mr. Ogilvie. Numerous points were fixed in latitude by sextant observations, and a number of chronometer longitudes were obtained. In 1877 Dr. Dawson made a general reconnaissance of the southern interior of British Columbia. In 1882, 1883, and 1884 Mr. Bowman, the importance of the district having been increased by the completion of the Canadian Pacific railway, extended the work of 1877.

The geological intricacies of the region, however, necessitated the doubling of the scale of the original map, and, consequently, the re-delineation of the topography. Of the four new sheets which now cover the old map-area, the north-west or Kamloops sheet was re-surveyed in 1888 to 1890 by Dr. Dawson and his topographical assistant, Mr. McEvoy. A loose network of triangles, based on the Canadian Pacific railway and other surveyed lines, was carried out between points, each of which was occupied as a transit station and sketch-point, elevations being determined barometrically and by angles of elevation. Other details of topography were filled in from paced and track surveys checked by latitude observations. The north-east or Shuswap Sheet was surveyed in the same way by Mr. McEvoy in 1891, 1892, 1894, and 1895. This, with the Kamloops sheet, forms a contoured map of 12,800 square miles of rugged mountainous country on a scale of 4 miles to 1 inch. The topographical work for a similar sheet to the south-east of the Shuswap has been in progress since 1894. This, the so-called West Kootanie sheet, is under the direction of Mr. McConnell, who has been assisted in 1894 and 1895 by Mr. Russell, and in 1896 and at the present time by Mr. McEvoy. The latter has completed for publication a detailed plan of Trail creek mining district on a scale of 1 mile to 1 inch.

In 1889 Dr. Dawson made surveys with boat-log of the Upper and Lower Arrow lakes and northern portion of Kootanie lake, and track surveys of the intermediate portions of the Columbia and Kootanie rivers between Revelstoke and Nelson. In 1893 Mr. McConnell, assisted by Mr. Russell, made a track survey of the Finlay river from its confluence with the Parsnip to Lake Thutade, 220 miles; of the Omineca river from its mouth to the Omineca-Sitleka pass, 113 miles; and of the trail from Old Hogem to Tacta lake, 42 miles. In 1893 Mr. McEvoy surveyed 300 miles of the Nasse river and its tributaries, and made 230 miles of exploratory traverses on foot.

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